

## Personally Adjustable Footwear

FIELD AND BACKGROUND OF THE INVENTION

This invention relates to footwear, particularly footwear whose size is adjustable.

5       The term "footwear" when used herein, is to be taken in its broadest sense and denotes shoes, sneakers, sandals, clogs, boots, skates, sportswear for the foot, etc.; and any of these terms may be substituted herein for the term "footwear".

There is known in the art shoes whose longitudinal dimension is adjustable by a variety of ways.

10       US 524,946 (Kregel) discloses a shoe intended for fitting to a deceased person for viewing and interment. Adjustability is achieved using an elastic band extending between a heel portion and toe portion designed to draw the heel portion forward to snugly fit to the foot of the deceased.

15       US 641,642 (Gunn) discloses a shoe, being adjustable length-wise and width-wise, the sole of which comprises a frame part at the shoe's heel and a shank at the middle/front of the sole. The frame part and shank are slidable with respect to one another to the extent of a slot in the shank. Upon adjusting to a desired length, the length of the sole is fixed by tightening a screw. The shoe comprises an upper, or top portion, designed to accommodate inserts on the right and left sides thereof, which can  
20       be folded to allow adjustment of the top portion of the shoe. The insert is secured by a lacing cord which passes between two vertical rows of eyelets. A similar arrangement is used to adjust the width of the shoe, with laterally arranged slots.

25       US 2,009,684 (Affronte) describes a shoe, having a similar length adjusting means wherein the shank has a tongue being slidable within a receiving portion of the heel section of the sole. The tongue has a plurality of holes for allowing a screw to pass and fix the tongue to the heel section at a hole corresponding to the desired shoe length.

US 2,497,175 (Mantos) provides a shoe formed of two main sections designed to be joined together by workmen in the shop of a shoe dealer whereby the size of the

shoe can be adjusted to a given size prior to completing assembly of the shoe. A metal shank projecting from the toe section of the sole comprises an integral fork aligned with a metal sheath or plate mounted in the heel portion of the sole. The fork has tines with triangularly shaped lugs along their edges corresponding to receiving members on the sheath to allow the toe and heel sections of the shoe to be securely attached to produce a shoe having any number of discrete lengths.

US 3,389,481 (England) shows an expandable shoe having a mid-section of bellows-like material permitting longitudinal expansion and contraction along a sliding guide having a locking mechanism to secure the fit at a desired length. The locking mechanism comprises a metal shank having two sliding plates, one of which has a transverse slot for receiving a detent formed in the other plate. A screw assembly extending up through the heel is removed to allow the plates to slide over one another, and then it is reinserted to retain the shoe in the newly extended position.

US 3,997,985 (Shina) discloses a stretchable shoe, particularly suitable for a growing child, comprising a front member and a rear member which may be adjusted in length. The front member and the rear member are separable and inter-connected by a screw which passes through one hole of the front member and one of a plurality of holes of the rear member. The front member is composed of an upper, an insole, a middle plate and a bottom plate, and the rear member is composed of a sole, an upper and a heel.

US 5,659,980 (Lin) discloses an adjustable shoe which has a heel, a toecap and an insole. The front portion of an instep has a plurality of positioning protrusions. First and second fastening pads are disposed on two outer sides of the heel. First and second ball buttons are disposed on the rear surface of the heel. An adjustable pad with positioning holes therein is disposed on the toecap from which two flaps extend. The inner surface of the flap has a fastening element. The first and second positioning plates are extended from the back of the outsole. The first positioning plate holds the first socket button and the second positioning plate holds the second socket button.

US 6,138,385 (Jungkind) describes a shoe sole having a jointed middle section located between toe and heel portions of the sole. The middle section is made of an

elastically flexible of springy material configured as a wavy or folded web with crests and troughs. A spindle runs from the heel to the toe portions and has a head located inboard of the rear edge of the heel portion. The spindle is rotatable/screwable into a nut whereby the shoe can be adjusted in length.

- 5           It would therefore be advantageous to provide footwear whose size can be adjusted by the wearer. It would also be advantageous to provide such adjustable footwear which is personalizable and easily and quickly re-adjustable.

### SUMMARY OF THE INVENTION

- 10           The present invention relates to footwear whose size can be conveniently and easily adjusted without any need for tools.

Such footwear typically comprises a toe portion (hereinafter "*toe*"), a heel portion (hereinafter "*heel*"), composing a sole and may also include a top portion or so-called upper.

- 15           According to the teachings of the present invention there is provided, personally adjustable footwear comprising: (a) at least one sole layer including: a toe portion, a heel portion, and an intermediate portion, the intermediate portion being integrally formed with both the toe portion and the heel portion, the intermediate portion having a plurality of openings passing substantially vertically through the layer so that the intermediate portion is elastically flexible to allow relative  
20           longitudinal displacement of the toe portion and the heel portion to vary a length of the layer without significant variation in a thickness of the layer; and (b) a retention mechanism associated with both the toe portion and the heel portion, the retention mechanism being configured for retaining any of a plurality of relative positions between the toe portion and the heel portion.

- 25           According to a further feature of the present invention, the toe portion, the heel portion and the intermediate portion are all integrally formed from a uniform composition.

According to a further feature of the present invention, the plurality of openings are deployed to provide a latticework pattern as viewed from above.

According to a further feature of the present invention, the at least one sole layer has an upper surface providing a foot support, wherein the plurality of openings are configured to have a maximum open longitudinal dimension no greater than about 2.5 centimeters so as to provide near-continuous foot support.

5        According to a further feature of the present invention, the at least one sole layer is implemented as at least two sole layers including a lower sole layer having a bottom surface configured for ground engagement and an upper sole layer including an upper surface for supporting a foot.

10       According to a further feature of the present invention, the upper sole layer is formed from a material softer than the lower sole layer.

      According to a further feature of the present invention, the lower sole layer and the upper sole layer are shaped to define therebetween at least one longitudinal channel extending longitudinally between the toe portions and the heel portions, and wherein the retention mechanism includes an element deployed within the channel,  
15       the element being anchored to a first of the toe portion and the heel portion and being displaceable relative to the second of the toe portion and the heel portion.

      According to a further feature of the present invention, wherein the sole layer forms at least part of a sole arrangement, the sole arrangement including at least one longitudinal channel extending longitudinally between the toe portion and the heel  
20       portion, and wherein the retention mechanism includes an element deployed within the channel, the element being anchored to a first of the toe portion and the heel portion and being displaceable relative to the second of the toe portion and the heel portion.

      According to a further feature of the present invention, the retention  
25       mechanism further includes a stepped resistance arrangement associated with the element and the second of the toe portion and the heel portion, the stepped resistance arrangement providing a resistive force opposing relative displacement of the toe portion and the heel portion between a plurality of predefined relative positions corresponding to a plurality of different lengths of the sole arrangement, such that a  
30       length of the sole arrangement is manually adjustable by manual application of force

to overcome the resistive force, and such that, in the absence of manually applied force, the toe portion and the heel portion are retained in one of the predefined relative positions.

According to a further feature of the present invention, the intermediate portion  
5 is resiliently biased to separate the toe portion and the heel portion to a predefined relative position corresponding to a maximum length of the sole arrangement, and wherein the retention mechanism further includes: (a) a flexible strap associated with the element and extending from the sole arrangement such that tension applied to the flexible strap relative to the second of the toe and the heel portions draws together the  
10 toe portion and the heel portion, thereby shortening the length of the sole arrangement; and (b) a locking arrangement for locking the flexible strap in a plurality of positions, thereby retaining the sole arrangement at a desired length.

According to a further feature of the present invention, the locking arrangement includes a first part of a hook-and-loop fastener associated with an end portion of the  
15 flexible strap and a complementary part of a hook-and-loop fastener associated with an upward-facing surface of the sole arrangement such that the flexible strap is folded onto the upward-facing surface to lock the sole arrangement at a desired length.

According to a further feature of the present invention, the retention mechanism further includes a manually releasable and manually engagable locking  
20 mechanism for locking a position of the element relative to the second of the toe portion and the heel portion.

According to a further feature of the present invention, the retention mechanism includes a manually releasable and manually engagable locking mechanism for locking a relative position of the toe portion and the heel portion.

25 According to one embodiment of the invention, the footwear comprises a series of sole segments (laterally oriented, longitudinally oriented, or a combination thereof) disposed between the toe and the heel. These segments can be added or removed to adjust the size of the footwear; or, they may be spaced further apart or closer together to adjust the footwear size.

Each of the segments comprises an arrangement allowing them to be fixed between the toe and heel. One option for such an arrangement is by having at least one, and typically two or more, parallel bores which are oriented to run longitudinally to the footwear while extending from the toe toward and into the heel, or vice versa, there are one or more segment holding members (e.g. rod-like members, cables, tongue-like member(s), etc.) adapted to be aligned with the bores of the segments and with corresponding bores in the heel (or toe, if vice versa). The segment holding members may be fairly rigid, however with appropriate resiliency/flexibility to allow for suitable movement when the footwear is being worn; however, they may be stretchable, for example, rubber band-like members. Depending upon the option, the heel or toe may comprise a locking mechanism, which would be appropriate, for example, to an embodiment comprising rod-like members extending between the toe and heel.

Segments adapted for this option are typically in the shape of a bar with a square profile, however, they may be of any of a variety of shapes, styles, colors, shapes, etc., and include aesthetic ornamental or artistic features so that the wearer can modify the style of the footwear to his or her taste – as may segments usable in other options, described below.

Another option for fixing segments between the toe and heel is by their being adapted to inter-engage or inter-connect with each other and to engage with the toe and heel. Inter-engaging may be by a variety of arrangements, including “Lego<sup>TM</sup>-type” connections, snap-fitting, screw-fitting, twist-fitting, hooking, hook and loop fasteners (Velcro<sup>TM</sup>), etc.

According to another embodiment of the invention, the footwear comprises toe and heel portions connected therebetween by a bellows-like structure, constituting a middle section, being compressible and/or expandable at least in the direction longitudinal to the footwear.

Projecting from the toe is a tongue that extends into a corresponding tongue receptacle in the heel, or vice versa. The tongue comprises a plurality of linearly arranged holes passing therethrough and alignable with corresponding to holes in the

tongue receptacle. The heel comprises a top portion which can be bent upward and having a plurality of downward projections or pegs adapted to pass through the holes of the tongue and into the bores/depressions of the tongue receptacle. The size of the footwear can be adjusted by lifting the top portion and sliding the toe and the heel toward each other, or apart, until a size, corresponding to an alignment of the holes of the tongue and tongue receptacle is achieved. The top portion is then lowered to fix the length.

Optionally, the footwear can include an arrangement for facilitating alignment of the pegs and corresponding bores. Further, the tongue may comprise an indicator to point to indicia adjacent the tongue receptacle which indicates the size of the shoe at a given adjustment portion.

According to an additional embodiment of the present invention, the footwear's toe and heel each comprise members (e.g. finger-like members, typically in a male/female connection) which extend toward and engage with each other. The members are slidable with respect to each another to allow for different footwear length, and typically have profiles shaped in such a way as to prevent vertical displacement.

At a desired length, a tongue with at least one extending peg/projection can be inserted into a tongue receptacle at the heel.

Thus, the present invention provides footwear whose size can be conveniently and easily adjusted without any need for tools, possibly by a wearer thereof. The footwear according to embodiments of the invention is readjustable, thus it can be adjusted to a variety of lengths at any time.

### BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, embodiments will now be described, by way of non-limiting examples only, with reference to the accompanying drawings, in which:

**Fig. 1** is a perspective view of an embodiment of adjustable footwear according to the present invention;

**Fig. 2** is an exploded view of the embodiment shown in **Fig. 1**;

**Fig. 3A** is a longitudinal sectional view along line III-III in **Fig. 1**;

5 **Fig. 3B** is a sectional side view of a modification of the embodiment of **Figs. 1-3**;

**Fig. 4** is a longitudinal sectional view showing another modification to the embodiment shown in **Fig. 1**;

10 **Fig. 5A** is a perspective view of a segment usable in any of the embodiments of **Figs. 1-4**;

**Figs. 5B-5J** are perspective views of segments for use in further embodiments of adjustable footwear of the present invention;

**Fig. 6** is a perspective view of another embodiment of the present invention;

**Fig. 7** is a longitudinal sectional view of the embodiment shown in **Fig. 6**;

15 **Fig. 8** is a top perspective view of a further embodiment of the present invention;

**Fig. 9A** is a sectional view taken through plane IX-IX of **Fig. 8**;

**Fig. 9B** is a sectional view analogous to that of **Fig. 9A** illustrating an exemplary modification of the embodiment shown in **Fig. 8**;

20 **Fig. 10** is a bottom perspective view of the embodiment shown in **Fig. 8**;

**Fig. 11** is a bottom view of a modification of the embodiment of **Fig. 1**;

**Fig. 12A-12C** are side views of exemplary segments for use in the embodiment of **Fig. 11**;

25 **Figs. 13A and 13B** are upper and lower exploded isometric views, respectively, of a first variant of the embodiment of **Figs. 6 and 7**;

**Figs. 13C and 13D** are upper and lower exploded isometric views of a slight variant of the implementation of **Figs. 13A and 13B**;

**Figs. 14A and 14B** are isometric views of a second variant of the embodiment of **Figs. 6 and 7**, shown in an elongated and shortened state, respectively;

30 **Fig. 14C** is a partial exploded view of the implementation of **Fig. 14A**;



Fig. 15A is a partially cut-away lower isometric view of a third variant of the embodiment of Figs. 6 and 7;

Fig. 15B is a longitudinal cross-sectional view taken through the implementation of Fig. 15A;

5 Fig. 16A is an isometric view of a fourth variant of the embodiment of Figs. 6 and 7;

Fig. 16B is an isometric view of a retention mechanism from the implementation of Fig. 16A;

10 Figs. 17A and 17B are isometric views illustrating a further optional form of openings for rendering an intermediate sole portion flexible for implementation of the present invention; and

Fig. 18 is an isometric view of deployment of a set of size indicating indices for use in the above-referenced implementations according to a further feature of the present invention.

## 15 DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1-5, a first embodiment, including particular modifications, of an article of footwear, generally designated as 10, of the present invention, is illustrated. The footwear 10 comprises a toe portion 12 (hereinafter "*toe*") and a heel portion 14 (hereinafter "*heel*") and a plurality of segments 16 disposed therebetween. Extending from the toe 12 toward the heel 14 is at least one (and typically more than one) segment holding member in the form of a rod-like member – for example, four rods 18 as illustrated in Fig. 2.

20 The segments 16 typically have a geometry wherein they have a length and a width, the length being longer than the width – in other words an aspect ratio greater than one. The segments 16 may comprise an indication of their size, in particular the dimension affecting the length of the footwear 10. Such an indication may be a numeral thereon indicating its dimension, or a color, shape, decoration, etc., corresponding to a dimension. However, the segments 16 may be of various shapes,

colors, etc., merely for decorative purposes. The segments 16 may also be made of different materials for functional (e.g. wear-strength, comfort) and/or decorative purposes.

5 The segments 16 have essentially horizontal holes or bores 20 (best seen in Fig. 4) adapted so that the rods 18 can pass therethrough. For this purpose, at least some of the segment's bores 20 are alignable with each other. In this manner, the segments 16, which constitute a middle portion of the sole of the footwear, can be incorporated into the sole or removed therefrom whereby the size of the footwear 10 is adjustable.

10 The heel 14 also has holes or bores 24 being alignable with the rods 18 and thus alignable with at least some of the bores 20 in the segments 16. The heel's bores 24 are adapted to receive the rods 18 (i.e. free ends 22 thereof). The rods 18 extend into the heel 14 where they are fixed in place by a locking mechanism 26.

15 The locking mechanism 26 comprises, for example, a top portion 28 and a bottom portion 30, at least one or the other of the portions adapted to hold or clamp the rods 18 in place. Typically, the portions 28 and 30 are designed to be engageable with each other, in any known manner. For this purpose, the portions 28 and 30 may have engagement members 28a and 30a, respectively.

20 In order to adjust the size of the footwear 10, the locking mechanism 26 is disengaged allowing the heel 14 to be slid back away from the toe 12 whereby it is removed from the rods 18. Then, segments 16 are added or removed to increase or decrease the length of the footwear 10. The heel 14 is then replaced, and then the locking mechanism 16 is reaffixed.

25 To further accommodate such adjustment, if the footwear 10 is a sandal or "flip-flop" or "thong" type, wherein it typically incorporates a toe-strap 32, the positioning of said toe-strap 32 may be altered. For this purpose, at least some of the segments 16 may further comprise (essentially) vertical bores 34 (Figs. 3A, 3B and 4) adapted to receive attachment projections 36 of the toe-strap 32 which can be attached (fixed in place) by any known means.

30 As understood from the exploded view of the footwear 10 in Fig. 2, the toe 12 can be composed of layers, for example an outsole layer 121, an insole layer 122 and

an intermediate layer 123. Such a design may be convenient for manufacturing and allow for portions/layers of different characteristics. For example, the outsole layer 121 may be made of a wear resistant material for increasing the life of the footwear 10 and the insole layer 122 may be made of a relatively soft or compliant material for comfort of a wearer.

Fig. 4 illustrates an article of footwear 10'' being a modification of that described with reference to the preceding figures. Here, the footwear 10'' comprises at least some segments 16a having at least one transverse bore 38; best seen in Fig. 5A. A segment 16b shown in Fig. 5A illustrates the possibility of the segment having both bores like bores 20 and like bore 38; thereby providing different options for achieving a given footwear length as well as a particular aesthetic aspect (e.g. different colors on each face of the segment) or flexibility thereto.

Additionally, the segments 16b could include bores 20a essentially perpendicular to bores 20 such that the segment could be incorporated in the footwear 10 rotated a quarter turn/rotation to that shown in Fig. 5A. This feature could have advantages in situations, for example, where any of the segments 16b have designs thereon or are shaped in a way that the overall design of the footwear can be changed (by turning/rotating segments), thereby giving the wearer the option to "self-design" the footwear to his/her taste. Bore 38 also provides flexibility in this regard.

It should be understood that the heel 14 could be designed in a manner analogous to that just described with respect to the toe 12, and vice versa. In other words, referring now to Fig. 3B, there may be footwear 10' of the present invention wherein the rods 18 extend from a heel 14' toward a toe 12' and being locked in place by a locking mechanism 26' at the toe 12', *mutatis mutandis*.

It should also be noted that rather than providing several extension segments 16, there may be provided one or more segments, the length of which may be predetermined or be set to suit an individual's foot size, e.g. by trimming the length of such segments.

Figs. 5B-5I illustrate various examples of segments which may be used in adjustable footwear according to further embodiments of the present invention. The

segments shown in these figures do not require a segment holding member (rod, tongue, cable, elastic, etc.) rather instead they comprise inter-engaging or inter-corresponding members, typically male-female type engagement elements.

In Fig. 5B there is shown a segment **116** having a “Lego<sup>TM</sup>-type” configuration. Thus, it has projections **118** (only one is seen) and indentations **120** which are designed to correspond to indentations and projections of other similarly configured segments. Naturally, a toe and heel of footwear used in an embodiment shown in Fig. 5B would also have corresponding projections or indentations, as the case may be, so that the segments **116** could be suitably joined thereto. It should be understood that this latter situation is the same for all of the segments described in Figs. 5B-5I, and therefore this fact shall not be repeated.

In Fig. 5C there is shown a segment **216** being similar to segment **116** of Fig. 5B, however it comprises an elongated projection **218** and a slotted indentation **220** – again, designed to correspond to an indentation and projection of other similarly configured segments.

In Fig. 5D there is shown a segment **316** comprising a wide hook-shaped projection **318** and a rod **320**. For illustration purposes, the segment **316** is shown with a partial cutaway in the area of the rod **320** and typically the rod **320** would be attached to the rest of the segment at both its ends to provide strong support. To join such segments **316** with each other, one segment is angled to allow the hook-shaped projection **318** to be slid under the slotted indentation **320** of another segment, and then it is arranged to be flush to that other segment.

Fig. 5E presents a segment **416** being similar to segment **316** of Fig. 5D, however it comprises a pair of resilient projections **418** that can inter-engage with a rod **420**. Again, for illustration purposes, the segment **416** is shown with a partial cutaway in the area of rod **420**. To join such segments **416** with each other, one segment is pushed toward another segment causing the projections **418** to first open when nubs **422** of the projections **418** contact the rod **420** of another segment, and then to close around the backside of the rod **420** in a snap-fit manner.

Fig. 5F shows another segment **516** connectable to like segments; as above. Here, the segment **516** comprises a screw-like projection **518** that can inter-engage with a threaded indentation **520**. To join such segments **516** with each other, one segment is simply turned so that its screw-like projection **518** screws into the threaded  
5 indentation **520** of another segment.

Fig. 5G shows yet another example of a segment **616** connectable to like segments. Here, the segment **616** comprises a projection, for example an L-shaped projection **618** that can inter-engage with a corresponding indentation **620**. The indentation **620** comprises a slot **622** and the projection comprises an arm **624**, the slot  
10 having a length dimension **d1** typically being a bit longer than a length dimension **d2** of the arm **624** of the L-shaped projection **618**.

To join such segments **616** with each other, a first segment is turned 90° so that its L-shaped projection **618** fits into the slot **622** of the other segment, then the first segment is pushed flush to the other segment, and lastly it is turned 90° so that the arm  
15 **624** enters an arm-receiving cavity **626** of the indentation **620**.

Fig. 5H shows yet a further example of a segment **716** connectable to like segments. Here, the segment **716** is a puzzle-like piece and comprises a projection **718** adapted to fit into an indentation **720** by either sliding transversely or by a pressure/snap fitting method.

Fig. 5I provides an embodiment showing another example wherein segments are inter-connected. Here, segments **816** (only one shown) have hook and loop fasteners (Velcro™) **818** and **820** adhered to their sides whereby they can attach one to the next.

Fig. 5J illustrates another embodiment wherein segments are inter-connected. However, in this case there are segments **916** that remain connected while being  
25 movable in relation to each other in that they can be spaced apart, to various degrees, or be positioned adjacent each other. This option can be accomplished, for example, as seen in Fig. 5I.

The segments **916** have segment connecting members **918**, for example nail-shaped members having a head **920** and a stem **922**. The segments **916** comprise  
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cavities **924** (shown with dashed lines) within which the heads **920** and a portion of the stems **922** are located; these also being shown with dashed lines where they are internal to the segments **916**. The cavities **924** are shaped such that the connecting members **918** can be slid back and forth whereby the segments **916** may be positioned  
5 closer or farther from each other.

To fix the distance, the cavities **924** are adapted to fairly snugly hold the connecting members **918**, or the segments **916** may be held in place by one of several alternate methods (e.g. such as described below).

Figs. 6 and 7 illustrate another embodiment of the present invention, providing  
10 an article of footwear, generally designated as **100**. Here, disposed between a toe **12a** and a heel **14a** is a flexible bellows-like intermediate portion **50** which connects the toe and heel and provides size flexibility to the footwear **100**. More specifically, as illustrated in Figures 6 and 7, footwear **100** includes at least one sole layer including:  
15 toe portion **12a**, heel portion **14a**, and intermediate portion **50**, the intermediate portion being integrally formed with both the toe portion and the heel portion, preferably from a uniform composition. It is a particularly preferred feature of this embodiment, and of the variants of this embodiment described below, that intermediate portion **50** features a plurality of openings passing substantially vertically through the sole layer so that intermediate portion **50** is elastically flexible to allow  
20 relative longitudinal displacement of the toe portion and the heel portion to vary a length of the layer without significant variation in a thickness of the layer. In this context, the term “vertically” is used to refer to a direction generally perpendicular to the ground-engaging surface and/or foot supporting surface of the footwear.

Footwear **100** also features a retention mechanism associated with both toe  
25 portion **12a** and heel portion **14a** and configured for retaining any of a plurality of relative positions between the toe portion and the heel portion. Preferably, the sole arrangement includes at least one longitudinal channel (also referred to as a “passage”) extending longitudinally between the toe portion and the heel portion, and the retention mechanism includes an element (in this case, a tongue **52**) deployed  
30 within the channel. The element is anchored to either toe portion **12a** or heel portion

14a and is displaceable relative to the other portion (heel portion 14a or toe portion 12a, respectively).

Thus, in the example illustrated in Figures 6 and 7, the toe 12a has a tongue 52, which may be integral therewith or attached thereto, adapted to be slidable through a passage (not seen) in the intermediate portion 50. The tongue 52 comprises a plurality of through-holes 54 being collinear and typically equally spaced apart. The heel 14a comprises a tongue receptacle 56 having depressions 58 corresponding, and similarly spaced, to holes 54.

The heel 14a comprises a top portion 60 adapted to be upwardly bendable, exposing the tongue receptacle 56. The top portion 60 includes at least one downwardly projecting peg-like member 62, arranged, and of a size, to pass through the tongue's holes 54 and be engagedly receivable in the depressions 58 of the tongue receptacle 56, for example, in a snap-fit type manner.

To adjust the size of the footwear 100, the heel's top portion 60 is lifted (illustrated by dashed lines in Fig. 7), thereby decoupling the peg-like members 62 from the depressions 58 and lifting them out from the holes 54. The toe 12a and the heel 14a are then slid toward or away from each other to respectively decrease or increase the length of the footwear 100. This may entail compressing or expanding the intermediate portion 50 for which purpose it is made of a flexible, resilient material.

When a desired length is achieved, within the tolerance of the distance between the spaced-apart holes 54, the size of the footwear 10 can be fixed. This is accomplished by aligning the tongue's holes 54 with the tongue receptacle depressions 58 and closing the heel's top portion 60 downward to recouple the peg-like members 62 with the depressions 28.

Optionally, there may be provided a marker 64, such as an arrow or projection, associated with the tongue 52, along with indicia 66 adjacent the tongue receptacle 56, for indicating a shoe size. This marker/indicia arrangement may also be useful for making it easier to align the tongue's holes 54 with tongue receptacle's depressions

58; for example, by means of a projection/socket (male/female component) arrangement for ensuring alignment.

It should be understood that the function provided by the heel's top portion 60 could alternatively be provided by a bottom portion thereof or even by a top or bottom portion of the toe 12a, *mutatis mutandis*.

Turning now to Figures 13A-18, these illustrate a number of variant implementations based upon the concept of footwear 100, and more specifically, wherein a sole arrangement includes at least one layer formed with a flexible intermediate portion for allowing elongation and contraction of a length of the sole arrangement. These variant implementations differ from footwear 100 described above primarily in: (a) the shape of the vertical openings through the layers used to impart flexibility to the intermediate portion; and (b) the implementations of the retention mechanism.

Turning now specifically to Figures 13A and 13B, these show an implementation of personally adjustable footwear 1000, constructed and operative according to the teachings of the present invention. Footwear 1000 has a sole arrangement assembled primarily from an upper sole layer 1002 and a lower sole layer 1004, and which form between them a channel 1006 (Fig. 13B) which receives a tongue 1008. At least one, and preferably both, of upper and lower sole layers 1002 and 1004 is formed with a toe portion 1012 and a heel portion 1014 interconnected by an intermediate portion 1010 which features a pattern of vertical openings 1016.

Openings 1016 are preferably deployed to provide a latticework pattern as viewed from above, i.e., a pattern of crisscross strips with roughly parallelogram openings between them, thereby imbuing the intermediate portion with greatly enhanced facility to accommodate longitudinal extension and/or compression while keeping the dimensions of the individual openings relatively small so that the upper surface of upper layer 1002 provides comfortable near-continuous support for the foot of a user. The term "foot support" in this context is used to refer to an element or surface which provides the primary mechanical support to the underside of the foot, but need not be in direct contact with the foot. Thus, the "foot support" may be



overlaid by one or more layers of padding or other functional or aesthetic layers. In order to provide the aforementioned near-continuous support for the foot, the plurality of openings are preferably configured to have a maximum open longitudinal dimension no greater than about 2.5 centimeters.

5           It should be noted that the use of substantially vertical openings to provide the required flexibility has profound advantages over the various solutions proposed by the aforementioned prior art documents. Firstly, since each layer is integrally formed, the production processes required are simple and cost effective, thereby rendering the footwear suitable for large scale production. Secondly, since flexing occurs primarily  
10       within the plane of the sole layer, the thickness of the layer remains substantially unchanged during elongation or shortening of the footwear, thereby allowing the upper surface of the upper sole layer to be used directly as a foot support surface without requiring complicated arrangements of overlapping and sliding rigid insoles or the like.

15           It should be noted that the subdivision of the sole layers into toe portion, heel portion and intermediate portion does not imply any particular relative dimensions between the portions, and that there is no lower limit to the size of the toe portion and heel portion. Thus, one or both of the toe portion and heel portion may optionally be implemented as end portions of the sole layers so that the adjustable-length  
20       intermediate layer with its vertical openings occupies a major portion, or even substantially the entirety, of the length of the sole.

          As mentioned, the entirety of each layer **1002** and **1004** is preferably formed integrally from material of substantially uniform composition, the varying mechanical properties being provided by the geometrical form of the layer. The separate layers, on  
25       the other hand, may be produced from different materials to provide particular desired footwear characteristics. Thus, by way of non-limiting example, upper sole layer **1002** may be formed of relatively soft resilient material to increase wearing comfort while lower sole layer **1004** may be formed of relatively harder abrasion resistant material offering a hard-wearing ground-engaging surface. Suitable materials for providing the

required mechanical properties, and suitable associated manufacturing techniques, are well known in the art and will not be addressed here in detail.

As mentioned above, lower sole layer **1002** and upper sole layer **1004** are shaped to define therebetween at least one longitudinal channel **1006** extending  
5 longitudinally between toe portions **1012** and heel portions **1014**. Tongue **1008**, which is deployed within channel **1006**, is anchored to either the toe portions **1012** or the heel portions **1014** and is displaceable relative to the other. In the case shown here, tongue **1008** is anchored to toe portions **1012** by a shaped head portion with a central hole which engages a corresponding socket and projecting tab formed in the underside  
10 of upper sole layer **1012**.

The implementation of Figures 13A and 13B is preferably formed with intermediate portion **1010** resiliently biased to separate the toe portion and the heel portion to a predefined relative position corresponding to a maximum length of the sole arrangement. This simplifies the mechanical requirements on the retention  
15 mechanism which then needs only act to limit the length of the footwear to a desired length against the inherent elasticity of the sole arrangement. In this case, the retention mechanism further includes a flexible strap **1018** associated with tongue **1008** and extending from the sole arrangement such that tension applied to the flexible strap relative to heel portion **1014** draws together toe portion **1012** and heel portion **1014**,  
20 thereby shortening a length of the sole arrangement. A low friction slide strip **1019** is optionally provided to help ensure free longitudinal movement of the strap **1018** at its relative thick point of attachment to tongue **1008**. A locking arrangement is also provided for locking the flexible strap in a plurality of positions, thereby retaining the sole arrangement at a desired length.

25 In the particularly preferred implementation illustrated here, the locking arrangement includes a first part of a hook-and-loop fastener **1020**, such as the fastener type typically referred to by the name Velcro™, associated with an end portion of flexible strap **1018** and a complementary part of a hook-and-loop fastener **1022** associated with an upward-facing surface of the sole arrangement such that the  
30 flexible strap is folded onto the upward-facing surface to lock the sole arrangement at

a desired length. Although the hook-and-loop fastener is a particularly preferred option due to its convenience and continuous adjustability, it should be noted that alternative fasteners are also within the scope of the invention. Examples include, but are not limited to, snap-in-studs, various plug-and-socket arrangements, and various types of pins or hooks. In all cases, the fastener is preferably chosen to be a manually operated fastener which does not require any tools or any difficult manipulation to perform.

For simplicity of presentation, the implementation shown here is a sandal of the “thong” type, having an aperture **1024**, slits **1026** and clips **1028** for retaining the straps in the required positions. As before, the principles of the present invention are equally applicable to all types of footwear, as will be clear to one ordinarily skilled in the art.

Turning now briefly to Figures 13C and 13D, these show an implementation closely analogous to that of Figures 13A and 13B, differing primarily in that channel **1006** and the socket and tab for accommodating tongue **1008** are formed primarily in the upper surface of lower sole layer **1004**. In all other respects, the implementation of Figures 13C and 13D may be fully understood with reference to the description of Figures 13A and 13B. It should further be noted that other configurations, including but not limited to, implementations where the sole arrangement is formed from a single unitary layer with a suitable channel formed therethrough, or where the channel passes along the upper or lower surface of the sole arrangement, also fall within the scope of the present invention.

Referring briefly to Figure 18, it should be noted that implementations of the present invention employing straps folded onto the surface of the sole arrangement may also be provided with arrangements of indices indicating the corresponding shoe size to which the footwear is adjusted. In this case, the indices preferably appear on an upward facing surface of the sole arrangement and are aligned with a corresponding mark, tab or cut-out window formed in the flexible strap **1018**.

Turning now to Figures 14A-14C, these show a further implementation of footwear, generally designated **1050**, constructed and operative according to the

teachings of the present invention. Footwear **1050** is generally similar to footwear **1000**, and equivalent elements are labeled similarly. Footwear **1050** differs from footwear **1000** primarily by the inclusion of an additional stepped resistance arrangement.

5            Specifically, the retention mechanism of footwear **1050** includes a stepped resistance arrangement, associated with tongue **1008** and heel portion **1014**, configured to provide a resistive force opposing relative displacement of the toe portion and the heel portion between a plurality of predefined relative positions corresponding to a plurality of different lengths of the sole arrangement. As a result, a  
10   length of the sole arrangement is manually adjustable by manual application of force to overcome the resistive force, while in the absence of manually applied force, the toe portion and the heel portion are retained in one of the predefined relative positions. In other words, when flexible strap **1018** is not fastened, the sole arrangement can be taken in two hands by a user and the toe and heel either pulled apart or pushed  
15   together, passing through a plurality of states each defined by a positive “click” position. Then, when the desired length of the footwear is achieved, flexible strap **1018** is fastened as described above to provide supplemental fixing of the desired length.

             One preferred example of an implementation of the stepped resistance  
20   arrangement is visible in the partial exploded view of Figure 14C. In this case, tongue **1008** is formed with a pair of resilient outwardly-biased tabs **1052** which engage a sequence of V-shaped notches **1054** formed along sides of channel **1006** within heel portion **1014**. The resilience of tabs **1052** and the angle of notches **1054** are chosen to ensure that the sole arrangement can be manually and non-destructively adjusted by  
25   application of axial compression or tension while providing sufficient resistive forces to retain a current length in the absence of significant externally applied forces.

             The combination of the stepped resistance arrangement together with the flexible strap fastening arrangement is considered particularly advantageous since it combined the convenience of temporary fixing of the length prior to attachment of the  
30   strap fastening with the positive fastening effect of the strap arrangement.

Nevertheless, it should be appreciated that both the strap fastening arrangement and the stepped resistance arrangement are each considered to be individually useful as freestanding products in their own right.

Turning now to Figures 15A and 15B, it should be noted that many other arrangements may be used to implement the aforementioned stepped resistance arrangement. By way of a further non-limiting example, Figures 15A and 15B illustrate a stepped resistance arrangement wherein the lateral engagement of the previous implementation is replaced with a vertically undulating arrangement. Specifically, this implementation of an item of footwear **1060** employs a tongue **1008** having a vertically undulating tail portion **1062** which passes over and/or under corresponding undulating configurations formed in the overlying surface of the upper sole layer and/or upper surface of the lower sole layer. This arrangement provides a similar stepped resistance effect to the notched arrangement described above.

Turning now to Figures 16A and 16B, there is shown a further variation of footwear, generally designated **1070**, constructed and operative according to the teachings of the present invention, in which the retention mechanism includes a manually releasable and manually engagable locking mechanism for locking a relative position of the toe portion and the heel portion. In this case, a central tongue **1072** incorporated in the heel portion is formed with a bilateral series of recesses **1074** and a complementary fork **1076** incorporated in the toe portion is formed with outwardly flexible arms which bear engagement features **1078** for engaging the recesses. This arrangement provides manually operated positive locking of the length of the sole arrangement. This allows the use of an intermediate portion of the sole arrangement which is biased to either an intermediate length state or even the shortest length state, the sole arrangement being locked in a state with a desired degree of longitudinal extension (stretching) by the retention mechanism.

Referring briefly to Figures 17A and 17B, there is shown one example of an arrangement of vertical openings for the intermediate portion of the sole arrangement particularly suitable for implementations which are initially biased to their shortest state. Specifically, in this case, the sole arrangement is formed from one or more

layers which initially assumes an unstressed state having a series of staggered transverse slits in its intermediate portion (Figure 17A). When stretched longitudinally, the material of the intermediate portion opens up to form a latticework pattern as illustrated in Figure 17B.

5           According to a further embodiment of the present invention, illustrated in Figs. 8-10, there is an article of footwear **200** comprising elongated projections **70** extending from a heel **14b** toward a toe **12b** thereof. The profile of the projections **70** (Fig. 9A) corresponds to channels **72** in an elongated projection receiving portion **74** projecting from the toe **12b**.

10           The heel's projections **70** are slidable toward and apart from the receiving portion **74**. It should be noted however that the profile of the projections **70**, in combination with the shape of the receiving portions channels **72**, are of a geometry whereby the members are prevented from significantly sliding with respect to each other in the vertical direction. This is a much preferred situation for since it would  
15 otherwise be potentially inconvenient or uncomfortable to the wearer. It should be understood that many other profile/shape combinations are possible which would prevent such unwanted vertical displacement.

Fig. 9B illustrates one example of the many alternative interacting configurations for elongated projections and corresponding channels of a projection  
20 receiving portion. In this example, the projections are inverted T-shaped elongated projections **270**, which are engagable in correspondingly shaped channels **272** with a projection receiving portion **274**. It should be understood that such projections may be any of a variety of profiles in addition to those described above, e.g. L-shaped, bulb-shaped, J-shaped, Y-shaped, anchor-shaped, cross-shaped, and the like.

25           Appropriate design of the exemplary projections **70**, **270** and channels **72**, **272**, respectively, can allow the footwear **200** to be adjusted to a desired length and remain at such while it is worn, for example, via a pressure or friction inter-fitting of the projections and receiving portions. However, the footwear **200** typically will include an auxiliary locking arrangement, such as that now described.

An example of such a locking arrangement is shown in Fig. 10, wherein extending from the toe 12b toward the heel 14b is a tongue 76 which comprises at least one peg-like member projecting therefrom. The peg-like member is not visible, however it can be of a form similar to that described above with reference to Figs. 6 and 7. The heel 14b comprises a tongue receptacle 78 comprising a plurality of depressions 80 which are adapted to receive the at least one peg-like member.

The size of the shoe can be adjusted by removing the tongue 76 from the tongue receptacle 78, sliding the toe and the heel apart or together -corresponding to the desired footwear size - and then reengaging the tongue 76 and the tongue receptacle 78 (i.e. pressing the peg-like structure into a/the depression(s) ).

Once again, it should be understood that heel/toe (i.e. projections/receiving portion) could be arranged conversely and that the tongue could be disposed at either of the top or bottom of the sole of the footwear and could alternatively extend from the heel 14b, *mutatis mutandis*.

Fig. 11 shows a modification of the embodiment of Fig. 1 where there is footwear 110 wherein extending between a toe 112 and a heel 114 is at least one, typically more than one, segment holding member in the form of a stretchable member or elastic member 117 (two shown) running through segments 119 (therefore shown by dashed lines). The segments 119 can be added or removed upon pulling the toe 112 and heel 114 apart and the segment(s) is then fitted on the elastic member 117 or removed therefrom, respectively.

Figs. 12A – 12C provide some examples of segments which are suitable for use in the embodiment of Fig. 11. As such, Fig. 12A shows a segment 121 with one or more slits 123 adapted to allow the elastic member 117 to slide therealong the slits having a cavity 125 for holding the elastic member when the footwear 110 is assembled.

Fig. 12B shows a segment 131 having a transverse slit 133, the segment adapted to spread open whereby the elastic member 117 can be inserted or removed for adding or removing a segment, respectively.

Fig. 12C shows a segment 141 comprising two portions 143 and 145 held adjacent to each other by a hinge 147 at one end thereof and having a latch arrangement 149 at the other end thereof. To allow adding the segment 141 to the footwear 110, the segment can be opened by unlatching the latch arrangement 149 and pivoting the portions 143, 145 at the hinge 147 and fitting the segment around the elastic member 117. The reverse procedure is used to remove the segment 141 from the footwear 110.

It should be understood that segments such as segments 121, 131 and 141, and the like, can also be used in connection with the embodiment of Fig. 1.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown by the exemplary embodiments described hereinabove. Thus, it should be understood that numerous additional embodiments are within the scope of the invention, *mutatis mutandis*.

For example, regarding the embodiment described with reference to Figs. 1-5, the segments 16 and 16b need not be juxtaposed in an aligned manner and, for example, may be arranged in a fashion where they are staggered, angled, etc. thereby providing the wearer with different fashion options or individual expression. In this regard, it should be understood that the segments 16, 16a and 16b could be of a variety of shapes and colors and may comprise various ornamental features. Further, the bores 20 could be angled with respect to the heel/toe to facilitate assembly options for the footwear 10. Additionally, the segments 16, 16a and 16b could comprise a texture, for example, to provide a massaging effect to the wearer, for aesthetic purposes, for a combination of these, or for other purposes.

Further, the invention has been illustrated in relation to sandal type (i.e. so-called flip-flops or thongs), however, the invention also can embody footwear such as more conventional shoes and the like by incorporating known means for allowing the expansion/contraction of a footwear's upper portion (e.g. that described in the above-mentioned prior art).

In addition, it should be understood that features of the above embodiments may be combined or substituted for other features. For example, in connection to the



embodiments described with reference to Figs. 1-5, the segments **16**, **16a** and **16b** may be held on a segment holding member being a tongue-like member, in place of the rods **18**; and, those embodiments may incorporate locking mechanisms such as described with reference to Figs. 6 and 10.

- 5           It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the scope of the present invention as defined in the appended claims.